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EECE 555: TEACHING MATHEMATICS AND SCIENCE IN THE ELEMENTARY SCHOOL

Learning The Scientific Method Through The Great Penny Experiment

Background For The Teacher

In this unit, children will explore the steps of scientific investigation with the use of simple objects: a penny, a dropper, a ruler and a cup of water. Through the steps of the scientific method, written into this unit, the children learn to predict. test and come up with conclusions about their predictions. Ask your students to guess (predict) how many drops will fit on a penny, then take a vote. Talk about the United States as being democratic where we vote on things. Have your students realize that voting here, on How Many Drops Of Water Will Fit On A Penny is wrong and that the only way to find out the real answer would be to do the experiment. Your students will learn to compute averages for the numbers of drops reported on their data tables and will then create graphs to represent that data. Through this experimenting process the children will test out different variables and why will determine why it is sometimes necessary to control variables in their experiments. You may wish to have your students keep a journal, log, or lab notebook documenting their work using a scientific method format that includes such sections for writing down information as problem (question to be answered), hypothesis (a guess based on previous knowledge), materials (what they need to use), procedure (step by step instructions), results (what happens in their experiment), conclusions (why things happen) and variables (things that messed you up).

Activity One (1)

Does the distance between the dropper and the penny have an effect on how much water a penny will hold?

Ask your students if it will make a difference if you hold the water dropper close to the penny or far away from the penny when dropping the water. Drop a rock into a small basin or pan of water. Talk to your students about splashing. Ask them where the splash came from and why it occurred. Your students should be able to carry the rock/basin experiment over to their own experiment with the pennies. They should hypothesis and after testing conclude that as you increase the distance between the dropper and penny, splashing will begin to mess up their results. Allow your students to work on Penny Experiment A. Talk with your students about why doctors and scientists test experiments more than once. After allowing your students time (about two class periods) to test their results from various dropper heights, work with your students on computing averages for their test results and then work with them on graph techniques for sharing their results with others.

Activity Two (2)

Does the age of a penny have an effect on how much water you can fit on it?

Discuss with your students the possibility of having a new penny that looks old or an old penny that looks new. Could

someone have taken a new penny and made it look older than it should look. Could someone have put pennies away years ago, so that when you look at them now, they look brand new. When pennies tarnish some of the space that could be filled with water is now being filled with a different material. This will cause the penny to hold less water.After allowing your students to work on Penny Experiment B (about two class periods will be necessary for the trials, averages and graphs to be made) they should realize that the age of a penny has no effect on how much water a penny will hold. Instead it is the condition of the penny that makes a difference. They should also realize that using the cleanest most non-scratched penny they can find, will give the best results.

Activity Three (3)

Will shaking the table have any effect on how much water a penny will hold?

All through these experiments you will hear your students complain about someone bumping into their table and messing them up. Question your students as to why their results will be effected if the table is bumped or banged. Have your students work in small groups so that one can drop water while others shake the table and document information. Ask your students how a pan/basin of water will be effected it you pull sharply on the side of the pan. Using Newton's Law that a body at rest tends to stay at rest, we see that as

you pull on the pan, the water wants to stay in it's original position. The pan however is no longer in that position, so the water falls or spills onto the table. As students shake the table, the water will move back and forth on the penny until it spill over the sides of the penny. After allowing your students time to work on Penny Experiment C (two class periods) your students should also come to realize that besides the water spilling off the penny, it is not easy to drop water onto a moving penny or in this case a moving target.

Activity Four (4)

Which side of the penny will hold the most water?

Question your students as to why pennies hold water at all. After working with pennies for at least six class periods already, that should be able to tell you, that a penny is like a small pool. There is a ridge around the penny, a ridge, that raises up the side of the penny higher than the center of the penny. This allows water to fit on the pennies surface. Raised surface in the center of the penny would fill space that could be filled with water. The students, after making careful observations, should be able to predict which side will hold the most water on the idea that one side has more raised surfaces taking up space. Allow two class periods for your students to test the heads and tails sides of a penny several times. Your children should average their results and then make a graph based on their work.

After doing these experiments your students should know how to use the scientific method as a tool to solve problems. They should also have learned how to control a variable so that to get the best number of drops they should hold the dropper close to the clean, non scratched, penny on the tails side and should do this experiment on a table that can not be shaken.

series →

A penny experiment

table no. _____ Height of Drop

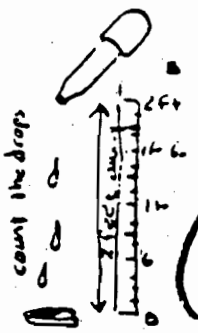
class name

_____ parent's signature

Problem: **Does the** distance between the dropper and the penny have an effect on how much water the penny will hold?

Development:

Q- If you dropped water from 2 feet how many drops would fill a penny? _____



Q- How can you find out for sure? _____

Q- How can you test to see if the distance between a penny and dropper has an affect on how much water the penny will hold? _____

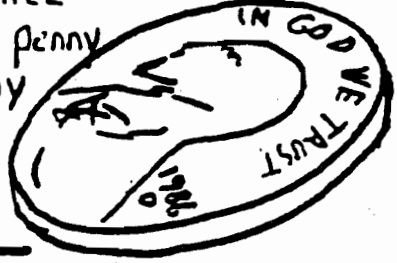
Q- Why should you test to see? _____

Table:

Graph results on table on a spiral sheet of paper

Distance	Guess	Trial 1	Trial 2	Trial 3	Average
9 inches					
4 inches					
1 inch					

Conclusion: What affect does the distance between the dropper and the penny have on how much water the penny will hold?



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penny experiment

table no. _____

class | name | Age

_____ parent's signature

Problem: Does the age of a penny have an affect on how much water you can drop on it?

Development (look closely at 4 (four) pennies)

Q - Tell something about them

	penny 1	penny 2	penny 3	penny 4
are they dull or scratched				

Q - Which penny will hold the most water? _____

Q - Why do you say this? _____

Q - Why do pennies wear out? _____

Q - How can you check to see if old worn out pennies will hold more less water than new pennies? _____

Table:

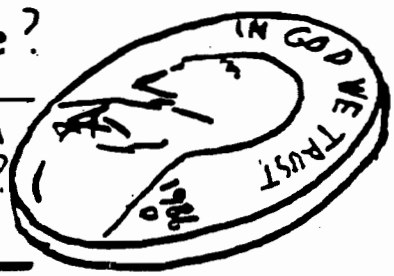
make sure All drops come from the same height and the same dropper

AGE (years)	Trial 1	Trial 2	Trial 3	Average

Conclusion:

Q - Why do you test more than once? _____

Q - What affect does age have on how much water a penny can hold? _____



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penny experiment C

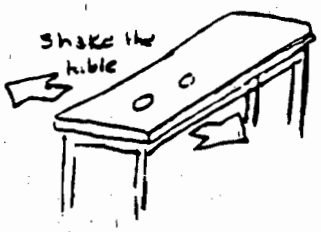
table no. ____ **Shaking the Table**

class | name

_____ parent's signature

Problem: Will shaking the table (that the pennies rest on) have any affect on how much water the pennies can hold?

Development:



Q - How do you think shaking the table will affect the amt. of water you can fit on a penny? _____

_____

Q - Why do you think this will happen?

_____

_____

Q - Why do you have to test your guess or "hypothesis"? _____

_____

Q - Why must you compare shaking the table to a set of results taken when not shaking the table? ____

_____

Table:

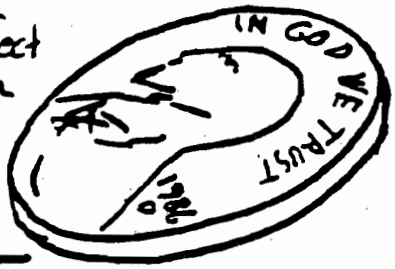
Action	Guess	Trial 1	Trial 2	Trial 3	Average
Do Not Shake					
Shake a little					
Shake alot					

Conclusion:

How does shaking the table affect the amount of water you can fit on a penny (that is on that table)? Why? ____

_____

_____



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Penny experiment D

table no____ Heads or Tails

class | name

_____ parent's signature

Problem: Which side of the penny will hold more water, heads or tails?

Development:

Q- Which side of the penny has more raised surface (things sticking up like edges, faces etc.)? _____

_____

Q- How might his affect the amount of water that that side will hold? ___

_____

Q- How can you tell for sure which side will hold more water? _____

_____

Q- Why should you test each side more than once? _____

_____

Table:

Graph these results on a seperate sheet

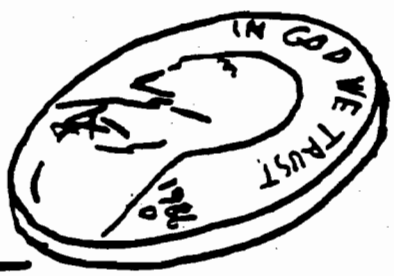
Side	Guess	Trial 1	Trial 2	Trial 3	Average
Heads					
Tails					

Don't average in your guess

Conclusion:

Q-Which side of the penny holds more water drops? Why?

Q-Vanables (like side of penny, shaking the table) mess you up. How can you avoid these things?



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series 2

PROBLEM: How does the height from which the water is dropped affect the number of drops?

name _____

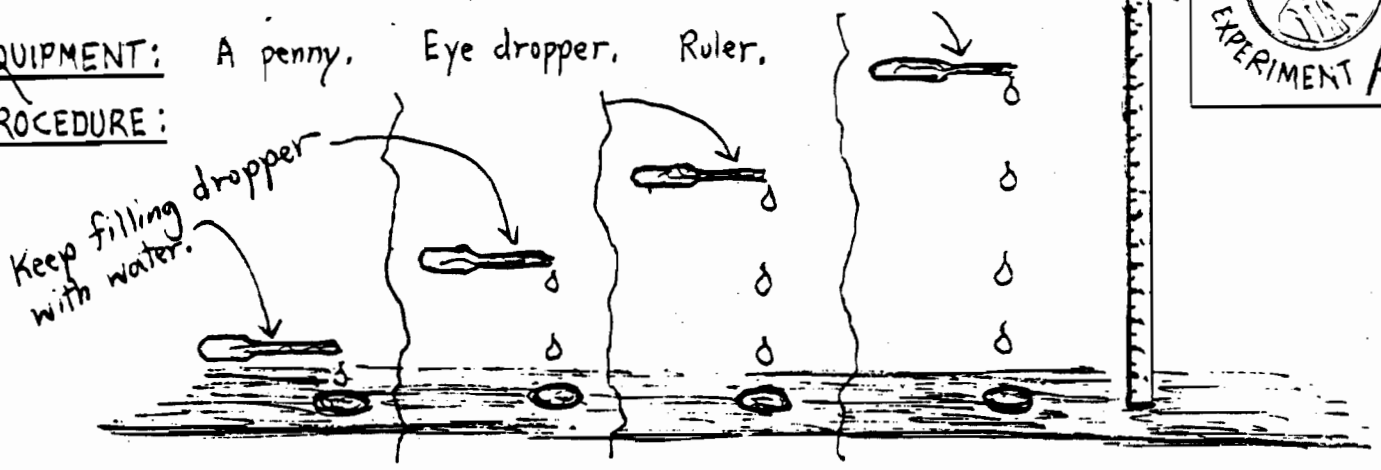
class _____

PENNY EXPERIMENT A

HYPOTHESIS:

EQUIPMENT: A penny. Eye dropper. Ruler.

PROCEDURE:



Find out how many drops of water you can put on a penny's 'tail' side when you hold the dropper 3 cm above the penny.
Try this three times, drying the penny each time.
Then find out how many drops you can put on the penny's 'tail' side when you hold the dropper 6 cm above the penny. Try three times.
Do the same three times at a distance of 9 cm
Do the same three times at a distance of 14 cm

Keep filling in this chart

RESULTS:

DISTANCE →	3 cm	6 cm	9 cm	14 cm
Trial 1 HOW MANY DROPS?				
Trial 2 HOW MANY DROPS?				
Trial 3 HOW MANY DROPS?				

QUESTIONS: Did you have any problems as the distance got greater?

At what distance was it easier to accurately measure how many drops could fit on a penny?

Using this information ↑, write your conclusion.

CONCLUSION: